Sentinel 3100
User Manual
DV and CP Models

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Warranty

This product is warranted to be free from defects in materials, parts and workmanship for a period of one year from the date of delivery. It will conform to the current product specifications upon delivery. Misuse, improper handling, unauthorized repairs or modifications, or use of the system outside of specifications will void this warranty.

Failure to maintain the enclosure rating for this product will void this warranty.

Shipping Damage

This unit is inspected before shipment. As soon as you receive the unit from the carrier, and before operation, inspect the unit for damage that may have occurred during shipment. If any damage is found, file a claim with the carrier and notify your Optech representative immediately.

Return of Unit

Before returning this unit, contact your Optech representative to obtain a Return Authorization Number. Optech will not accept units without an RA number.

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Revision History

Revision	Date	Description
Rev A	Nov 03	Update
Rev B	Aug 04	Update

Product Description Sheet

Product Name	
Enclosure Type	
Enclosure Serial No.	
Rangefinder Serial No.	
Software Versions No.	

Options Supplied with This Product

	Hand-Held Keypad		Sightglass - Unpressurized
	120 V AC/DC Power Supply		Flange Gasket
	120 VAC Heater and Power Supply		Sealing Gaskets
	PG13.5 Conduit Entry Set		Bezel Gasket
	Air Curtain		Universal Bracket
	Spray Ring		Aritculating Bracket
	Sightglass - Pressurized		Reflector Cluster

Special and Custom Features

Important Notices

Laser Pointer (page 7)

CAUTION

Visible Laser Light - Do Not Stare Into Beam

Program laser pointer to OFF after installation and alignment.

Do not stare into laser pointer beam.

Low and High Temperature Protection (page 31)

Rangefinder turn-on is delayed without warning at low temperatures until heater warms unit up to operating temperature; rangefinder and laser pointer are shut down without warning at high temperatures until unit cools down. No data is transmitted or accepted when rangefinder is shut down.

At cold temperatures, unit may take up to 45 minutes to turn on. Range readings may then fluctuate for first 15 minutes. Accuracy gradually improves as unit warms up.

Remote Programming via PC

Use upper case letters only (press CAPS LOCK).

Enclosure O-Rings (page 48)

To maintain water-proof seal, save and re-install all O-rings after servicing.

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1 OVERVIEW

This manual provides installation, programming, operation and maintenance information for users of the Sentinel 3100 level monitor. Both the Sentinel 3100DV and Sentinel 3100CP models are discussed in this manual. Unless otherwise stated, information applies to both models.

1.1 Terms Used in This Manual

To highlight important information, this manual uses the following signal words. Do not proceed until you understand the information and have complied with any instructions:

DANGER	Death or serious injury.
WARNING	Potential for death or serious injury.
CAUTION	Potential for minor or moderate injury; unsafe practices.
NOTICE	Damage to equipment or loss of data; policy on safety of personnel or protection of property.
IMPORTANT	Operation or maintenance suggestion; other useful information.

1.2 Type Conventions

This manual uses the following type conventions:

POINTER ON	Hardware labels
MAIN MENU	For text displayed on, or entered via, keypad or PC.

2 SYSTEM DESCRIPTION

Figure 1: Sentinel 3100 Level Monitor

The Sentinel 3100 is a laser-based, non-contact measurement system designed for industrial use as a level monitor. It is a member of Optech's Series 3000 family of industrial instruments.

DV Model	Optimized for performance in environments with excessive dust and vapor.
CP Model	Optimized for clear path applications.

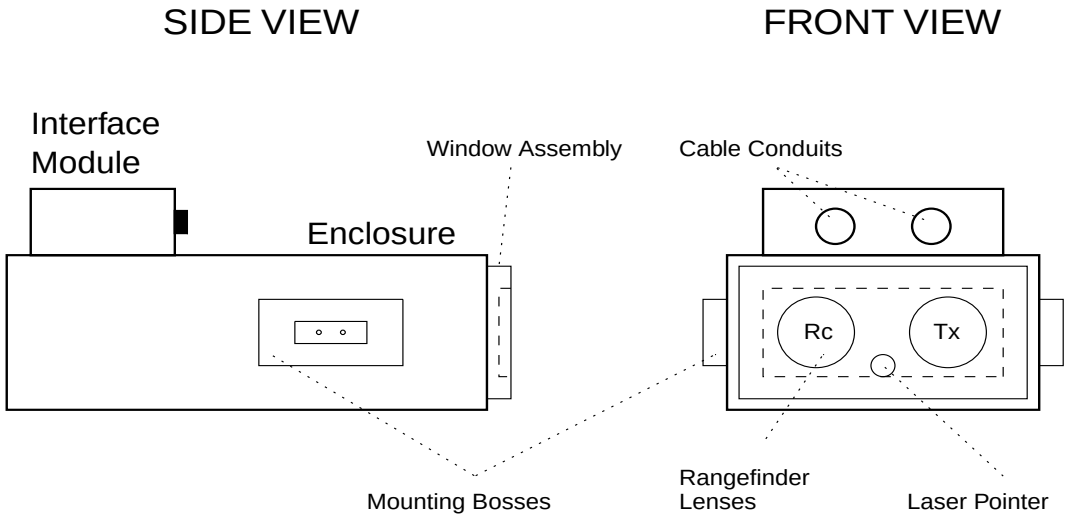


Figure 2: Main Features of the Sentinel 3100

Figure 2 outlines the main features of the Sentinel 3100 enclosure with the rangefinder installed. The unit consists of a rangefinder housed in a sealed enclosure, with a window installed over the rangefinder lenses and a small interface module mounted on the enclosure. All external power and data connections are made to a printed circuit board inside this module. In addition to a terminal block and a local RS-232C port, the board contains diagnostic light-emitting diodes (LEDs) and fuses.

Housed in a rugged, die-cast, aluminum enclosure, the Sentinel 3100 is configured for easy flange mounting and versatile surface mounting in any orientation. Mounting bosses and internal mounting holes on the base of the enclosure are provided for flexible installation.

The enclosure and the interface module are fully sealed to ensure dust and water-proof operation.

The Sentinel 3100 operates from a nominal input voltage of 24 VDC (120 VAC option available). Power input, analog data input/output, and RS-422 output are isolated up to 1000 VDC. The local RS-232C port is **not** isolated.

Options are available to customize the Sentinel 3100 for your particular operating and mounting requirements (see Appendix, page 61).

2.1 Principle of Operation

The rangefinder uses a laser diode to make non-contact range measurements to almost any target or material, operating in both dark and well-lit environments without using retro-reflectors or mirrors. The narrow laser beam produces no false echoes and resolves small targets at long range. It can be reflected from a diffuse surface at virtually any angle and still return to the unit to produce a range measurement.

To calculate the range, the time of flight of the laser pulse to and from the target/material is measured by a high-precision counter, and then converted into a range reading by a microprocessor. By firing the laser rapidly and employing averaging to reduce random errors, the rangefinder produces high-resolution readings independent of range.

2.2 Lasers

The Sentinel 3100 uses two laser sources:

Rangefinder laser	Invisible infrared beam (wavelength 905 nm) used to measure distance
Laser pointer	Visible beam (wavelength 635 nm) aligned with the rangefinder beam.

The laser pointer produces a red spot that indicates the point to which the distance is being measured. The pointer should be used only during installation, to verify alignment.

2.3 Programming

Embedded software enables you to customize many aspects of operation, with an optional keypad providing a simple and convenient user interface. The unit can also be programmed via PC or Palmtop computer.

A local, non-isolated RS-232C port can be used during installation to program and test the unit, and to monitor range readings.

All programming software is built into the Sentinel 3100; no separate software installation is required.

2.4 Outputs

The Sentinel 3100 outputs accurate range readings in RS-422 and analog data formats that are compatible with most industrial control and data logging systems. A bi-directional, non-isolated, RS-232C port is provided for local programming.

3 SAFETY

3.1 Visible and Infrared Laser

CAUTION

Visible Laser Light - Do Not Stare Into Beam

Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous exposure to laser light.

Use of optical instruments with pointer may increase eye hazard.

Program laser pointer to OFF after installation and alignment.

The Sentinel 3100 has two laser sources contained in the unit:

Invisible infrared (IR)	Used for range measurement
Visible beam	Used for alignment.

The infrared (IR) laser emits energy that is not visible to the human eye. It is designed as a Class 1M laser source as specified by IEC 60825-1:1993+A1:1997+A2:2001. In normal operation the IR laser is not considered hazardous. In normal installation and use, a person may view the laser light with the naked eye or with eyeglasses assisting vision.

The visible laser pointer is classified as a Class 2 laser product per IEC 60825-1: 1993+A1:1997+A2:2001. Class 2 denotes low power visible lasers or laser systems that, because of normal human aversion responses, do not usually present a hazard. In normal installation and use, a person may view the laser light with the naked eye or with eyeglasses assisting vision. The laser pointer emits continuous visible laser light at a wavelength of 635 nm.

The laser pointer light has an optical power of less than 1 mW and a spot diameter of less than 15 mm at a range of 5 m. The laser pointer is co-aligned with the rangefinder beam, and projects a red spot on any surface. Note that this beam spot may be hard to see in bright light.

When the two laser beams are considered together, the Sentinel 3100 is considered a Class 2M product per IEC 60825-1: 1993+A1: 1997+A2:2001. The Sentinel 3100 is therefore labeled as a Class 2M product; the two labels on the unit are shown in Figure 3. This labeling and classification system ensures that the Sentinel 3100 complies with all requirements of the European eye-safety standard (IEC 608251: 1993+A1: 1997+A2:2001) and with the United States eyesafety standard (21 CFR 1040, parts 10 and 11, and Laser Notice 50, dated July 2001).

As with many conventional light sources, there is some potential for hazard if the laser light is viewed directly for long periods.

Do not use optical instruments such as binoculars or other devices that collect light while the laser pointer is firing. As a standard laser precaution, do not stare directly into the laser, and do not install the Sentinel 3100 at eye level.

Use the laser pointer for alignment only, and not in normal operation. To prevent accidental exposure to the laser beam, Optech strongly recommends programming the pointer OFF through

software as soon as the Sentinel 3100 is installed and aligned. As a precaution, the pointer always defaults to OFF upon power-up.

VISIBLE AND INVISIBLE LASER RADIATION
DO NOT STARE INTO THE BEAM OR
VIEW DIRECTLY WITH OPTICAL INSTRUMENTS
CLASS 2M LASER PRODUCT
0.2 mW max output, 200 Hz, 10 ns pulse at 905 nm
0.99 mW max output at 635 nm

Figure 3: IEC Eyesafety Labels

3.2 AC/DC Enclosure Power Supply (120 VAC Option)

WARNING

120 VAC Shock Hazard

Optional power supply can cause death or severe injury.

Do not open enclosure when unit powered. Only qualified personnel should handle power supply and associated wires and connectors.

The optional AC/DC power supply converts an external 120 VAC power source into the 24 VDC used internally by the Sentinel 3100. The power supply is located inside the main enclosure, and is not accessible during normal operation. The fuse for this device is located at **F3** on the interface board, covered by a reusable fuse cover.

120 VAC is present on the interface board at terminals 12 and 13 of the terminal block and pins 34 and 36 of the 40-pin edge connector (terminal 14 is chassis ground). Live voltages may also be present at the power supply. When the Sentinel 3100 is powered, do not touch the above connections.

4 SPECIFICATIONS

All specifications are subject to change without notice. For additional information and other options, see appendix, page 61.

Measurement

	CP Model	DV Model
Range [1]	0.2 m to 150 m	0.2 m to 150 m
Absolute accuracy [2]	Within 2 cm	Within 4 cm
Operating accuracy [3]	Within 5 mm	Within 25 mm
Repeatability [4]	Within 3 mm	Within 4 mm
Resolution	1 mm	
Rate	Programmable from 1 reading every 5 seconds to 20 readings per second	
Maximum reportable range	300 m; at ranges greater than this the unit will output "invalid reading"	
Units of measurement	Meters or feet	
Zero reference point	Front surface of enclosure window frame (programmable)	

Outputs

Analog [5]	4-20 mA; max. load 1,000 ohms; 1,000 VDC isolation
Serial RS-422	Transmit only; 1,000 VDC isolation
Serial RS-232C	Bi-directional; for test and setup only; not isolated

1. Maximum ranges are typical and depend upon target reflectance, vessel conditions (e.g., dust), background radiation and sightglass ratings.
2. At a measurement rate of 1 reading per second, the specified accuracy is absolute over the full temperature range, with a variety of materials and at any distance, within 1 standard deviation.
3. At a measurement rate of 1 reading per second, this accuracy depends upon limited variations in temperature, material and distance associated with the installation.
4. At a measurement rate of 1 reading per second, under steady state conditions, within 1 standard deviation.
5. Analog accuracy is equal to absolute or operating accuracy ±0.1% of range.

Lasers

Wavelengths	905 nm (infrared rangefinder beam)
	Infrared beam divergence 5 mrad (0.28°)
	635 nm (visible laser pointer beam)

Eyesafety

	U.S. FDA 21 CFR 1040	IEC 60825
IR rangefinder laser	Class 1	Class 1M
Visible laser pointer	Class 2	Class 2

Power (1,000 VDC Isolation)

Input voltage	24 VDC nominal (10.5-30 VDC) or 120 VAC option
Power consumption	36 W max. @ 24 VDC

Environmental

Operating temperature [1]	0°C to +50°C
With AC heater	-40°C to +45°C
Storage temperature	-40°C to +70°C

3100 Enclosure

CE Marking [2]	Class A
Ratings	CSA 4X, 6; IP 67; Class I Div 2 Group ABCD; Class II Group EFG
Size	272 L x 202 W x 148 H (mm), including mounting bosses
Weight	7 kg (with rangefinder)

1. For 24 VDC operation.
2. 24 VDC operation only.

Options

AC/DC Enclosure Power Supply

Input voltage	120 VAC, 20 VA; 50-60 Hz
Operating temperature	-10°C to +50°C

AC Enclosure Heater [1]

Input voltage	120 V, 100 W max.
Operating temperature	-40°C to +45°C

Hand-Held Keypad

Display	4 lines x 20 characters liquid crystal display
Case	Molded, high impact ABS
Operating temperature	0°C to +50°C
Storage temperature	-20°C to +70°C

Air Curtain	Use dry, oil-free, instrument air

1. For AC operation down to -40°C.

5 UNPACKING

Upon receiving your unit, inspect the shipping carton for external damage that may have occurred during transit. Check the contents against the packing list, and inspect the unit for visible damage such as scratches and dents. If an item is missing or damaged, notify the carrier and your Optech representative immediately.

Check the enclosure window and ensure that it is clean and not cracked or scratched. For window cleaning instructions, see page 47.

6 CABLING

IMPORTANT

Power and data cables supplied by customer are required for operation.

Sentinel 3100 may fire as soon as power is supplied.

For cabling diagram, see Figure 9, page 28.

To simplify cabling and servicing, all external data and power connections are made to an interface module on the enclosure. In the module are a 14-pin terminal block (**J3**) and a 9-pin connector for RS-232C communication (**J2**). The external data and power lines are carried by ribbon cable from an edge connector to a D37 connector on the base of the interface module. This connector and its mate on the enclosure are the interface between the module and the enclosure. Ribbon cables run from this point to the rangefinder panel inside the enclosure.

All components are designed for quick and easy removal. The interface board and the module lid are each attached to the interface module by four captive screws. The module itself is mounted to the enclosure by four screws accessed from inside the module.

A wiring guide is provided inside the interface module (see also "J3 Terminal Block", page 16, and "J2 RS-232C Serial Connector (Local Programming)", page 17). All other data and power connections are internal.

Note that the RS-232C port is designed for commissioning test, installation and alignment only. It is not isolated, and is not intended to be permanently connected to a control system.

NOTICE

Save and re-install all O-rings before completing commissioning of unit. For location of O-rings, see page 48.

6.1 Cable Conduits

The interface module has two 1/2″ NPT cable conduits, both O-ring sealed. Optech can also provide a PG13 conduit entry set as an option (page 61).

6.2 Signal and Data Isolation

The power, RS-422 and analog current loop lines in the rangefinder and on the terminal block are isolated to 1,000 VDC. The RS-232C port is intended for testing and local communication only, and is not isolated. Before making connections to this port, determine whether a ground fault exists.

6.3 J3 Terminal Block

The terminal block is the primary interface between plant power and communications and the Sentinel 3100. Optech provides a mating plug that can be attached to outside cabling.

Table 1: Terminal Block Assignments

Terminal	Connection
1	+24 VDC
2	-24 VDC
3	Spare
4	Analog Current Loop 4-20 mA -
5	Analog Current Loop 4-20 mA +
6	RS-422 Transmit +
7	RS-422 Transmit -
8	Data Common
9	LASER ENABLE
10	EXTERNAL TRIGGER
11	Spare
12	120 VAC Line (Option)
13	120 VAC Neutral (Option)
14	AC Ground (Chassis Ground)

6.3.1 External Trigger

There are two external trigger inputs on the terminal block **J3**:

External Trigger	Terminal 10. This is a TTL, edge-triggered input: the unit executes one reading cycle on the negative (high-to-low transition) trailing edge of the trigger pulse.
Laser Enable	Terminal 9. This is a TTL, active low, input: the unit fires at the programmed repetition rate as long as the input is held low.

Since both inputs have internal pull-up resistors, the unit can be triggered by shorting terminal 9 or terminal 10 to the Data Common line (terminal 8).

6.4 J2 RS-232C Serial Connector (Local Programming)

This non-isolated connector is intended for local test, installation and alignment with Optech's keypad or another serial communication device. It is not intended to be permanently connected to a control system.

Table 2: J2 RS-232C Connector Pinout

Pin	Connection
2	RS-232C Serial Data Out
3	RS-232C Serial Data In
5	Data Ground
9	Remote +12 V

6.5 Serial Data Protocol

NOTICE

Before starting PC programming, press CAPS LOCK.

Serial RS-232C communication is established via Optech's optional keypad. Optech recommends using this keypad.

All programming software is embedded and available as soon as serial communication is established. Programming screens are shown on the range display.

If you want to store readings or do not have a keypad, you can use a PC instead. The Sentinel 3100 interfaces easily with any PC terminal communications program. To establish a serial data connection, your computer must be equipped with an RS-232C (or RS-422) port. Use the following settings:

RS-422	Tx only
RS-232C	Tx Rx (bi-directional)
ASCII characters	
Baud rate	9600
Data bits	8
Stop bits	1
Parity	None
Flow control	None (Xon/Xoff)
Serial port	According to your computer configuration.

For Windows 98™ or Windows NT™, use the HyperTerminal program with the below steps. If your PC is equipped with Windows 3.1™ software, follow these steps:

1. Select the **ACCESSORIES** icon.

2. Select **TERMINAL**, and then **SETTINGS** and **COMMUNICATIONS**.

3. Set communications parameters as listed above.

4. Save the correct settings to a file for quick recall.

7 MOUNTING AND APPLICATION INFORMATION

IMPORTANT

For installation drawings and information, see Chapter 8.

7.1 Mounting Elements

The Sentinel 3100 enclosure provides a variety of mounting options to suit specific applications and installations. The enclosure and the interface module are water-proof and dust-proof, as long as the module is properly installed on the enclosure and all O-rings and seals are properly installed and in good condition.

7.1.1 Mounting Bosses

The aluminum mounting bosses on the sides of the enclosure have two external, threaded, mounting holes:

M8	For standard installation using an M8 x 1.25 socket head cap screw.
1/4" NPT	For auxiliary mounting: for example, with heavy vibration, as a purging port, or as a cooling port.

7.1.2 Mounting Holes

For surface mounting or for extra rigidity, four threaded M8 x 1.25 holes are provided on the base of the enclosure in a 110 x 240 mm pattern.

7.1.3 Orientation of the Interface Module

The interface module is usually oriented so that the cable conduits are at the bottom of the module, shielded from weather and dust (when flange-mounted). To accommodate your installation, the module can be rotated 180° so that cabling emerges from the top. Note that in this case the D37 connector on the base of the module must also be rotated 180° to maintain its mating connection on the enclosure.

7.2 Mounting Configurations

7.2.1 Surface Mounting and Alignment

- Ensure that the support is sufficiently rigid to prevent misalignment.
- Before drilling through holes into the support, consider any future alignment problems or equipment that may obstruct the rangefinder beam.
- The degree of alignment depends upon the size of the mounting holes. To facilitate alignment, Optech recommends oversized holes with suitable clearance.
- To ensure the correct vertical alignment, use shims or washers.
- For information on Optech's optional articulating bracket and surface-mount installation, see "Appendix: Product Information", page 61.

7.3 Flange Mounting (Appendix)

CAUTION

Sentinel 3100 is not rated for exposure to higher than ambient pressure.

Use a sightglass for high-pressure or high-temperature environments.

- For pressure or vacuum vessels, a sightglass is required.
- If the installation site is very dusty, an air curtain may be required.
- If condensation forms on the sightglass or material settles on it, a spray ring may be required.
- When installing the Sentinel 3100 in its flange-mount bracket, consider the location of the mounting brackets in relation to the stud pattern on the mounting base, to take advantage of any inclination angle.
- When using a sightglass, cross-tighten the flange nuts to avoid putting a bending moment on the sightglass.
- Obey the bolting torque limits specified by the manufacturer for the size and material of the flange stud being used.
- Before final installation, clean all surfaces and seal them with suitable gaskets as shown in the appendix. Avoid invasive dust or moisture.

- Do not complete the final seal of the window assembly to the sightglass cover until the unit has been fully aligned and commissioned.

7.4 Other Mounting Configurations

For assistance with other mounting options, please contact Optech or your Optech representative. See also "Appendix: Product Information", page 61, for information on product options that may apply to your installation.

7.5 Application Information

7.5.1 Monitoring Liquids

- Install the Sentinel 3100 to range towards the liquid at an angle of 90°.
- For outside installation, consider the angle at which the sun strikes the liquid. A strong sunlight reflection from liquids can cause out-of-range measurements.
- Ensure that the unit will not be ranging to obstacles that may be hidden at the time of installation.
- The Sentinel 3100 works best when monitoring turbulent or agitated liquids. Still, motionless liquid with no waves or ripples can cause saturation problems and less accurate range readings. Specular reflections from the surface of the liquid may produce OUT OF RANGE errors (Table 7, page 52).
- In environments with dust, airborne particles, steam or fog, use last-pulse measurement mode ("First/Last-Pulse", page 41). If problems persist, contact Optech or your Optech representative.
- To ignore range readings from tank agitation and obstacles such as mixer blades, use filter programming ("Filter Distance and Timeout", page 42).
- If measurements are intermittent, use filter programming to compensate.

7.5.2 Monitoring Solids

- Incorrect readings may be reported during filling. Depending upon the size of the falling particles, the range to the unit, and the extent of the drop, the Sentinel 3100 may be able to range through the particles during a fill cycle.

- The alignment of the unit can be adjusted to range to the top of a cone on filling, and to the bottom of a cone on emptying.

- Ensure that the unit will not be ranging to obstacles that may be hidden at the time of installation.

- In environments with dust, airborne particles, steam or fog, use last-pulse measurement mode ("First/Last-Pulse", page 41). If problems persist, contact Optech or your Optech representative.

- If measurements are intermittent, use filter programming to compensate ("Filter Distance and Timeout", page 42).

8 INSTALLATION

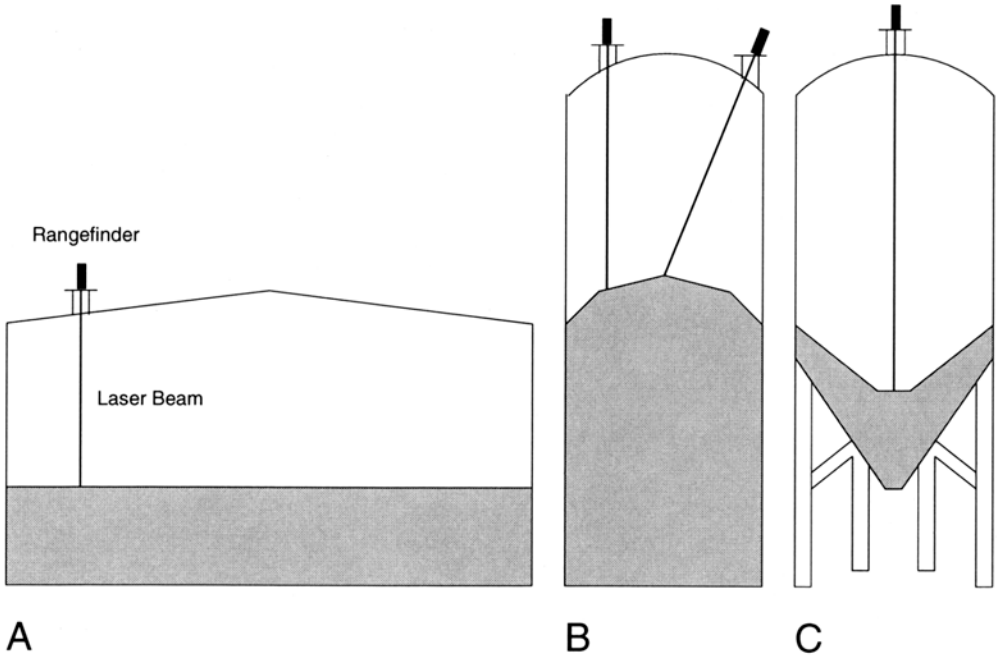


Figure 4: Installation Configurations

8.1 Installation Procedure

CAUTION

Visible and Invisible Laser Light - Do Not Stare into Beam

Before closing the interface module, program the laser pointer to OFF.

Sentinel 3100 may fire as soon as power is supplied.

NOTICE

Do not point the Sentinel 3100 at the sun.

Strong sunlight reflections can cause erratic range readings.

This procedure assumes that you are already familiar with the cabling and mounting information in Chapters 6 and 7. For installation drawings, see page 26. For information on installing product options, see "Appendix: Product Information", page 61.

Install

1. Locate a suitable installation site ("Mounting and Application Information", page 19, and Figure 4).

2. Install the unit, but do not secure it in place until final alignment is complete:

For	Use
Standard installation	M8 x 1.25 cap screws on mounting bosses
Extra rigidity/security	1/4" NPT mounting on mounting bosses
Surface mounting	M8 x 1.25 screws into enclosure base.

3. If you rotate the interface module to facilitate the cable routing or entry location, remember to rotate the D37 connector on its base as well, to maintain the mating connection with the enclosure. Optech recommends that, wherever possible, the conduit entry face down.

Cable and Power

1. Open the interface module.

2. Detach the module from the enclosure to simplify the task of cabling, if necessary.

   Save the five O-rings (on each mounting screw and the lid/module seal).

3. Run your power and data cables through the cable conduits.

> **NOTICE**
>
> Unit is fully sealed at factory. Failure to maintain sealed entry will void warranty.

4. Make all connections to **J3**, the terminal block on the interface board.

   To simplify the task of routing the wires, remove the mating connector on the terminal block, and re-install it when this step is complete. The unit operates off 24 VDC or 120 VAC (option). For **J3** terminal assignments, see page 16, or Figure 9, page 28.

5. For local RS-232C test and programming, plug in the optional keypad or remote device to **J2**, the 9-pin serial port.

   To use a remote device other than Optech's keypad or a laptop computer, see "Signal and Data Isolation", page 16, and "Serial Data Protocol", page 18. The device must be unplugged before the interface module can be closed.

6. Re-install the interface module on the enclosure:
   a) Check the five O-rings.
   b) Align the mating connectors.
   c) Plug in the module.
   d) Install the M4 mounting hardware on the lid, but do not replace the lid at this point.

7. Power ON (page 30).
   If the unit is too hot or too cold, the unit may not turn on immediately ("Thermal Protection", page 31).

NOTICE

At cold temperatures, unit may take up to 45 minutes to turn on. Range readings may then fluctuate for first 15 minutes. Accuracy gradually improves as unit warms up.

Align and Program

1. Program the laser pointer ON (page 36). Confirm that the red **POINTER ON** LED on the interface board is illuminated.

.

CAUTION

Visible Laser Light - Do Not Stare into Beam

Do not use binoculars or devices that collect light to locate pointer beam.

2. Locate the red pointer beam spot. The pointer beam is co-aligned with the rangefinder beam.

3. Align the unit.
   Use shims or washers to adjust the unit's position until the unit is correctly aimed. If the installation includes a sightglass, use Optech's gasket to mount the unit tightly to the sight-glass.

4. Program the laser pointer OFF. Confirm that the red **POINTER ON** LED on the interface board is now off.

5. Program the unit for plant operation (Chapter 1010). The unit is now ready for 4-20 mA analog output calibration, if desired.

Final Steps (After Alignment)

1. Unplug the RS-232C data cable.
2. Replace the lid of the interface module.
3. Tighten all mounting hardware.
4. Begin operation.

8.2 Installation Drawings

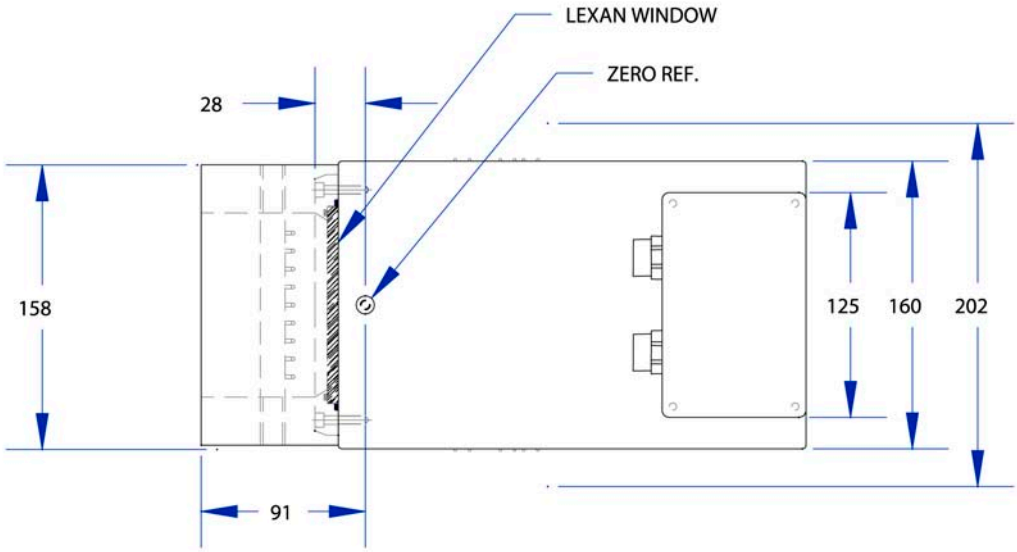


Figure 5: Unit Top View (205-000106)

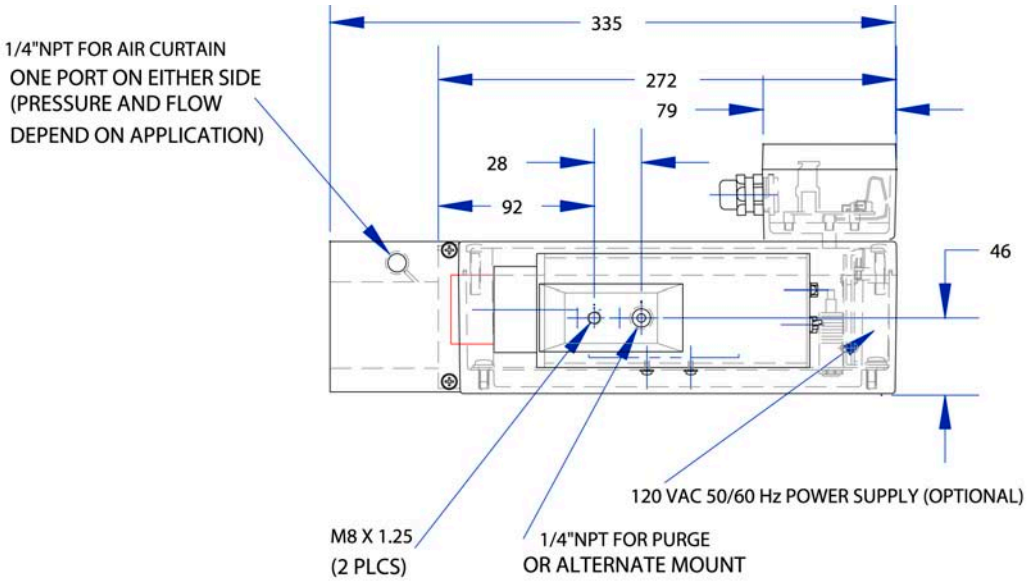


Figure 6: Unit Cross-Section (205-000106)

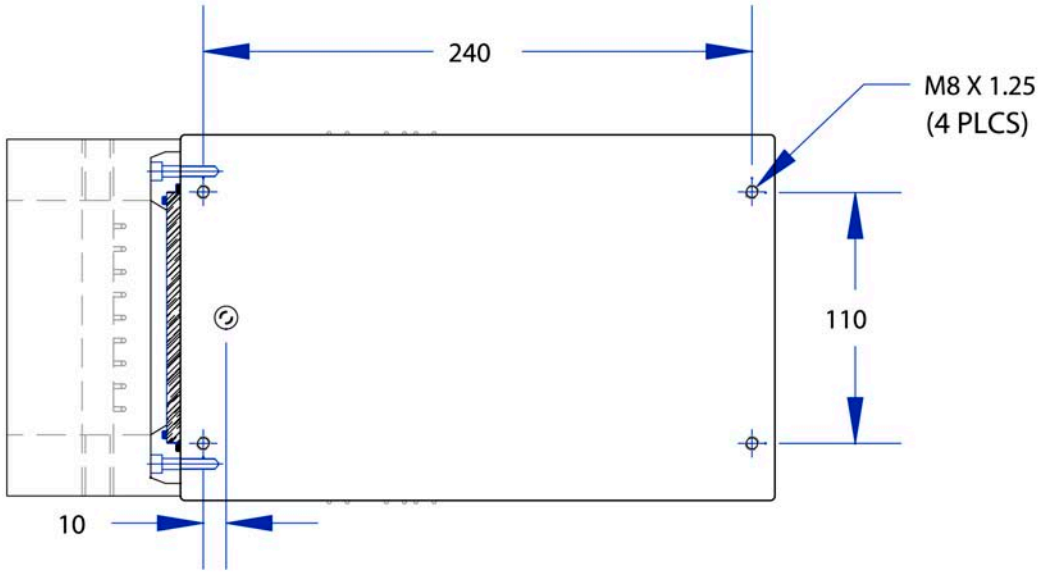


Figure 7: Unit Bottom View (205-000106)

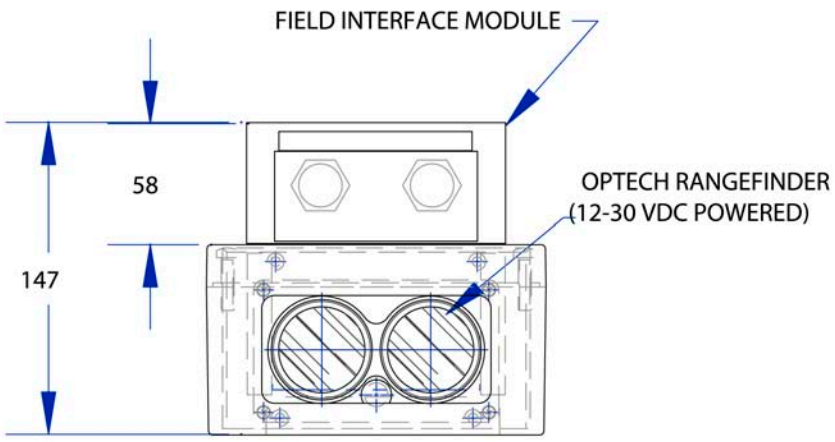


Figure 8: Unit Front View (205-000106)

8.3 Field Interface

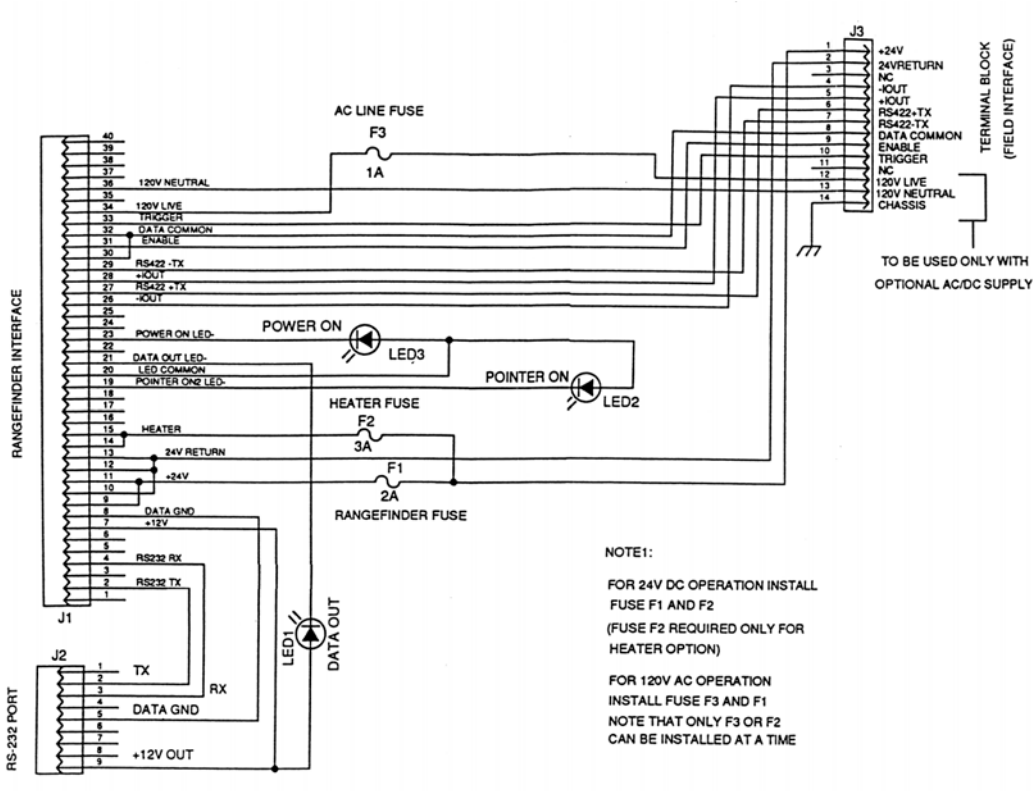


Figure 9: Field Interface Board Schematic (230-010073)

9 OPERATION

The Sentinel 3100 can be programmed and controlled remotely from Optech's hand-held keypad or from any device communicating via RS-232C and using ASCII characters. Programming is discussed on page 33.

Factory settings or the most recent programmed settings are saved and restored whenever the unit is powered ON again.

9.1 Operating Steps

1. Before powering the unit, check that:
   - Interface cables are firmly attached at both ends and will not come loose.
   - If using a PC, it is properly configured for remote programming, and CAPS LOCK is on ("Serial Data Protocol", page 18).

2. Power ON.
   The software version is briefly displayed on your keypad or PC. In continuous mode, the Sentinel 3100 begins to report range readings within seconds. In external trigger mode, the unit reports readings only when triggered ("External Trigger", page 17).

   NOTICE

   At cold temperatures, unit may take up to 45 minutes to turn on.

   Range readings may fluctuate for the first 15 minutes. Accuracy gradually improves as the unit warms up.

   Review and follow the laser safety precautions in "Visible and Infrared Laser", page 7.

3. Program other aspects of the Sentinel 3100 as outlined in Chapter 10, Programming, on page 33. Review also the operating notes in this chapter and the suggestions in "Application Information", page 21.

   Programming software is embedded; no separate software installation is necessary.

4. In external trigger mode, trigger range readings as desired ("External Trigger", page 17).

5. Monitor range readings, and change programmable settings as desired.

9.2 Powering ON/OFF

The Sentinel 3100 has no power ON/OFF switch. It is turned ON/OFF by the external power source.

Note that the laser pointer fires continuously if it is programmed ON.

9.3 Accuracy

9.3.1 Accuracy and Repeatability

The Sentinel 3100 averages a number of laser shots to produce each range reading. The number of shots averaged affects the accuracy of a reading: the higher the number of shots, the higher the accuracy of the resulting reading. Since the Sentinel 3100 fires a fixed number of shots per second, the measurement update rate (rate of readings) determines the number of shots that can be averaged, and thus the accuracy of the range reading:

Accuracy ↑ As Measurement Update Rate ↓

9.3.2 Accuracy Restrictions

At short range, a very strong return from a highly reflective target such as reflective tape will saturate the Sentinel 3100's range detector, and may produce a range reading with a degraded accuracy. In this case a SATURATION or SAT/DROPOUT error code will be output with the range (Table 7, page 52).

9.3.3 Low-Temperature Start

If the Sentinel 3100 is cold when it is first powered ON, it may begin firing before all its components have fully warmed up. In this case initial range readings may fluctuate. Range accuracy will gradually improve as the unit's internal temperature stabilizes, which takes about 15 minutes.

9.4 Thermal Protection

The Sentinel 3100's thermal protection is summarized in Figure 10 below.

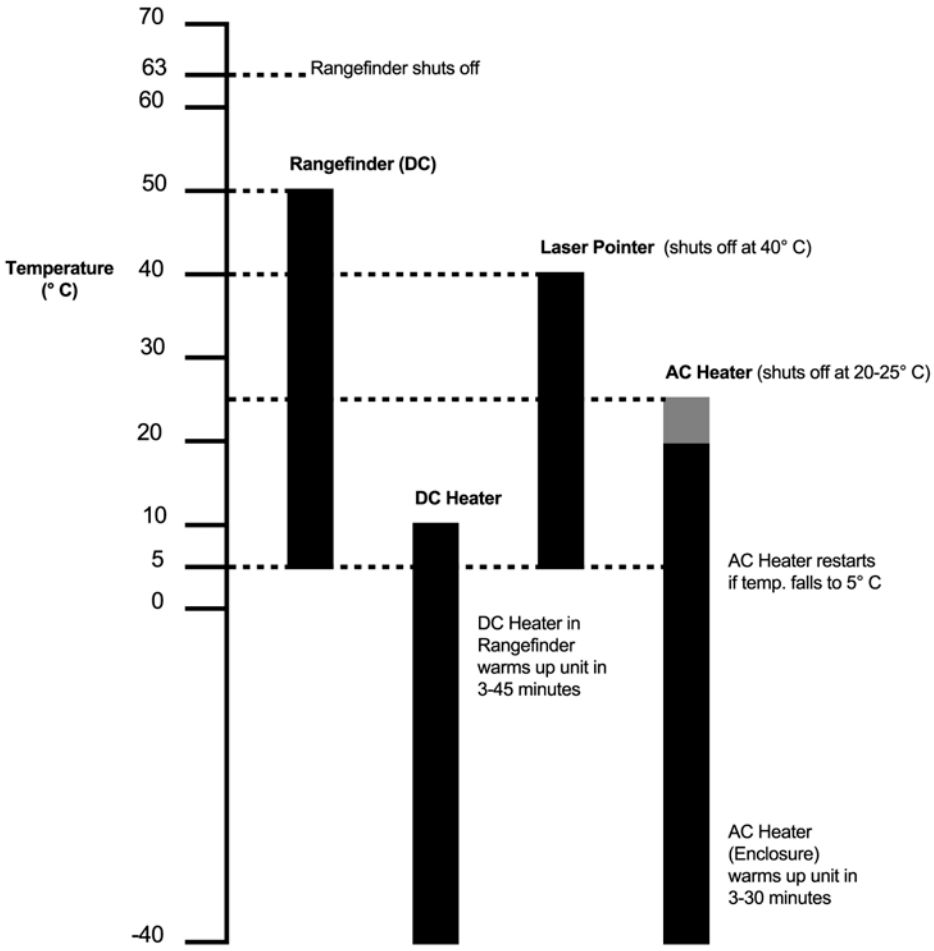


Figure 10: Thermal Protection

9.4.1 High-Temperature Rangefinder Protection

To protect the Sentinel 3100 from temperature extremes outside its specified operating range, the unit's power supply is automatically shut off without warning if the temperature of the rangefinder inside the enclosure:

Rises above 67°C ±3°C.

The power supply is re-enabled automatically and without warning when the temperature returns to an operable level. The unit then resumes operation with the same programmed settings as before shutdown, and begins reporting range readings again. (The laser pointer defaults to OFF.)

9.4.2 High-Temperature Laser Pointer Protection

To protect the laser pointer from temperature extremes above its specified operating range, the laser pointer is shut down automatically when the ambient temperature exceeds about 40°C. The pointer is automatically re-enabled when the temperature drops.

9.4.3 Rangefinder DC Heater

At internal temperatures below 0°C, the Sentinel 3100 rangefinder does not fire or output data. When the unit is powered on at such a cold temperature, a heater incorporated into the rangefinder turns on automatically to warm the unit to an operable level.

At very cold temperatures, it may take up to 45 minutes before the rangefinder is ready to fire. If your unit includes an AC heater, the warm-up time will be shorter.

The rangefinder begins firing when its internal temperature reaches 5°C, and the heater turns off at 8°C. Under most conditions, the rangefinder temperature will remain above 5°C from that point on. Should the temperature drop, the heater will turn on again.

9.4.4 120 VAC Enclosure Heater (Option)

For operation in very cold environments where 120 VAC is available, Optech offers an enclosure heater as an option.

If the temperature of the rangefinder inside the enclosure is below 0°C when the Sentinel 3100 is powered ON, the rangefinder will not turn on until the heater has warmed the rangefinder to an operable level (about 0-10°C). This may take up to 30 minutes, depending on the ambient temperature, after which the rangefinder will be warm enough to turn on. Thereafter the heater's thermostat will operate the heater up to a temperature of 20-25°C, at which point it will shut off.

The thermal cutoffs of the rangefinder and the heater thermostat set point are overlapped, to ensure that the rangefinder stays ON once it reaches operating temperature.

10 PROGRAMMING

IMPORTANT

Use the RS-232C port to program via keypad or PC with serial link.

Most recent programmed settings are restored when the unit is powered ON (laser pointer defaults to OFF).

To begin programming, press **M**.

Rangefinder laser does not fire during programming. Laser pointer continues to fire if programmed ON.

10.1 Summary of Screens and Programmable Settings

Programming software is embedded; no separate software installation is necessary.

On the following two pages are shown the hierarchy of programming screens for the Sentinel 3100 and a summary of settings that can be programmed via these screens. More detailed information is provided in the rest of this chapter.

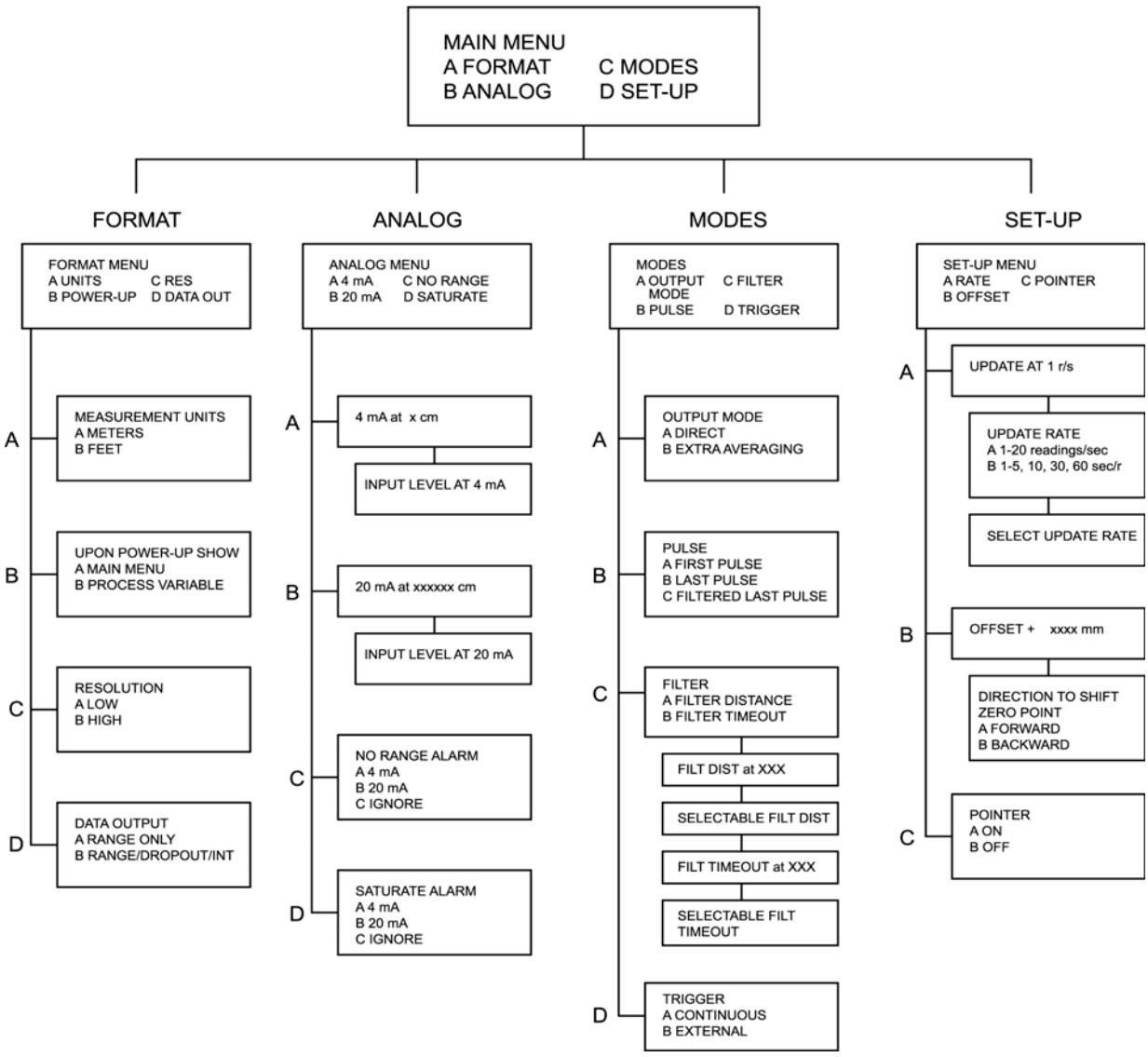


Figure 11: Programming Screens

Table 3: Programmable Settings

Setting	Options	Factory Default
Measurement Units	Meters, feet	Meters
Resolution	**Low**: 0.00 m (1 cm) or 0.1 ft **High**: 0.000 m (1 mm) or 0.01 ft	High
Trigger	**Continuous**: Unit internally triggered to output range readings at selected update rate. **External**: Unit outputs a range reading only when externally triggered.	Continuous
Data Output	**Range Only:** Outputs range readings only. **Range/Dropout/Intensity:** Outputs range readings as well as the number of laser shots that do not return to unit, and the relative intensity of return signals, from 0 to 6375.	Range Only
Analog Settings (Zero, span, inverse span)	**20 mA**: 0 to 50,000 cm **4 mA**: 0 to 50,000 cm	20 mA: 3000 cm 4 mA: 0
Output Mode	**Direct**: Target/material moving at >30 cm (1 ft) per minute. **Extra Averaging**: Target/material moving at <30 cm (1 ft) per minute.	Extra Averaging
Filter	**Filter Distance**: Range window for valid readings (0-325 m). **Filter Timeout**: Number of readings for which window distance is valid (0-127).	0 0
First/Last Pulse Mode	**First Pulse**: Use with a clear and unobstructed view of the target/material. **Last Pulse**: Use with interference such as fog, rain, dust, snow or objects between the unit and the target/material. **Filtered Last**: Use with heavy interference when lower accuracy is acceptable.	Last Pulse
Update Rate	From 1 range reading every 5 seconds to 20 per second.	1 reading/second

10.1.1 Hand-Held Keypad

To facilitate test and setup in an operational environment, Optech offers an optional hand-held keypad. The keypad uses RS-232C communication and plugs into **J2** on the interface board. It can be connected or disconnected at any time while the unit is powered ON.

10.1.2 Using the Programming Screens

When programming on PC, first ensure that CAPS LOCK is on. The programming screens are formatted for Optech's keypad, and do not look the same when displayed on a PC. The table below describes some of the most common screen operations.

Table 4: Common Programming Operations

Operation	Step
Begin programming	Press **M**
Exit most screens	Press **E**
Backspace over an entry (keypad)	Hold down SHIFT and press BACKSP
Choose screen option	Press letter, then press **E** to save and exit
Continuous update	Press **C**
Trigger mode	Press **S** to get a reading

10.2 Programming the Laser Pointer

CAUTION

Visible Laser Light - Do Not Stare Into Beam

Do not use binoculars or devices that collect light.

To program the laser pointer ON/OFF, press **P** at any time outside the programming screens.

The laser pointer is intended to help align the unit during installation and test only. For any other application, always program the laser pointer OFF. The pointer defaults to OFF upon power-up:

ON	For alignment
OFF	At all other times.

For more information, see "Visible and Infrared Laser", page 7.

10.3 Main Menu Screen

When you press M to begin programming, the following screen appears.

```
      MAIN MENU
 A FORMAT  C MODES
 B ANALOG  D RATE
    Press E to exit
```

To select a menu option Press A-D

To return to the range displayPress E

The rangefinder laser does not fire during programming, but the laser pointer continues to fire if it is programmed ON.

10.4 Format Screens

```
       FORMAT
A UNITS    C RES
B POWER-UP D DATA OUT
   Press E to exit
```

10.4.1 Measurement Units for Range Readings

```
 MEASUREMENT UNITS
A  METERS
B  FEET
   Press E to exit
```

Select whether you wish the unit to measure range in meters or feet.

10.4.2 Power Menu

```
 UPON POWER-UP SHOW
A  MAIN MENU
B  PROCESS VARIABLE
   Press E to exit
```

Select whether you wish to see the main menu or the process variable when the unit is powered up.

10.4.3 Range Resolution

```
    RESOLUTION
A LOW
B HIGH
   Press E to exit
```

	Resolution:	Example:
A LOW	0.00 m (1 cm) or 0.1 ft	7.54 m, 24.1 ft
B HIGH	0.000 m (1 mm) or 0.01 ft	7.545 m, 24.17 ft

10.4.4 Data Output

```
      DATA OUT
A RANGE ONLY
B RANGE/DROPOUT/INT
   Press E to exit
```

A RANGE ONLY
Only range readings are displayed, in the selected measurement units.

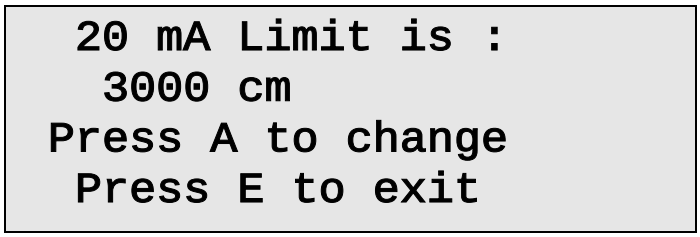
B RANGE/DROPOUT/INT
In addition to range readings, two other useful diagnostic values are displayed. The number of dropouts (laser shots that do not return to the unit) per range reading is a function of the selected update rate: at a high update rate, fewer shots are averaged per reading.

The intensity of the reflection is shown as a value from 0-6375.

10.5 ANALOG Screens: 4-20 mA Analog Range Settings

```
  ANALOG SETTINGS
A 4 mA   C NO RANGE
B 20 mA  D SATURATE
   Press E to exit
```

```
 4 mA Limit is :
    0 cm
Press A to change
 Press E to exit
```



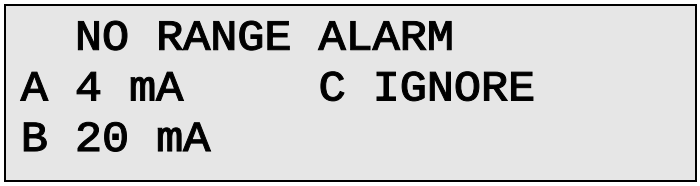
These screens set the ranges corresponding to the 4 mA and 20 mA analog limits. Ranges can be set for zero, span, and inverse span, and are displayed in the current units of measurement (centimeters or inches). The maximum value for either limit is 50,000 cm (19,695 inches).

Note that the value of the analog limit is exact if centimeters are used, but round-off errors reduce the accuracy using feet to under one inch.

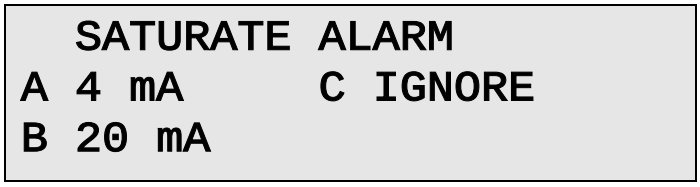
When you press A to change the limit, the following prompt appears:

INPUT A NUMBER FOR THE SETTING

Type a value and press ENTER. Press E to save the value, and check that it is now displayed.



Allows the user to program an analog output response to a "no range" reading, such as no signal return.



Allows the user to program an analog output response to a "saturated" reading, such as too strong a signal.

10.6 Modes Screens

```
MODES
A OUTPUT MODE C FILTER
B PULSE       D TRIGGER
   Press E to exit
```

10.6.1 Output Mode

```
OUTPUT MODE
A DIRECT
B EXTRA AVERAGING
   Press E to exit
```

A DIRECT
Outputs the range reading directly.

B EXTRA AVERAGING
Outputs a rolling average of the last five readings.

10.6.2 First/Last-Pulse

```
PULSE
A FIRST PULSE
B LAST PULSE
C FILTERED LAST PULSE
   Press E to exit
```

A FIRST PULSE
This mode is best if there is a clear and unobstructed view of the target/material, with no fog, steam, rain, snow, dust or other possible targets in the way. Range readings are made to the first object encountered.

B LAST PULSE

This mode improves ranging through fog, steam, rain, snow or certain quantities of dust. It can provide the correct range even if stationary objects partly block the unit's line of sight, as long as the objects are separated by more than 3 m (10 feet) and part of the laser beam travels beyond them. Range readings are made to the last object encountered, filtering out earlier returns.

C FILTERED LAST PULSE

This mode is similar to LAST PULSE, but the rangefinder is now optimized to range through very thick fog, steam, rain, snow or dust. This mode provides usable and stable ranges at the cost of possible lower accuracy (±0.5 to 8 cm). The PARTIAL DROPOUT symbol < may appear ahead of the serial range output. Note that the unit relies on line of sight; laser light must be able to reach the target/material and return to the unit for a measurement to be made.

10.6.3 Filter Distance and Timeout

```
  FILTER
A  FILTER DISTANCE
B  FILTER TIMEOUT
   Press E to exit
```

```
FILTER DISTANCE IS:
     0 cm
 Press A to change
  Press E to exit
```

```
FILTER TIMEOUT IS:
      0
 Press A to change
  Press E to exit
```

These screens provide a sliding window filter for both the analog and serial output. The Sentinel 3100 assumes that the longest readings are valid, and therefore uses a one-way window to ignore short readings outside the window. This screens out interference and obstacles passing between the unit and the target/material it is monitoring.

A valid reading within the window resets the reference for the next measurement.

Filter Distance - One-Way

The filter distance determines how much shorter a valid reading can be from the previous reading. Any shorter reading outside the window is ignored, while all readings longer than the previous one are considered valid.

The unit re-transmits the last valid measurement until another valid measurement occurs or the programmable filter time out expires. The maximum filter distance is 32,500 cm (12,795 inches).

Filter Timeout

The filter time out, measured in number of range readings, determines the number of readings for which the filter distance applies. After the timeout expires, the next measurement is valid whether it is within this distance or not. The maximum time out is 127.

The **FILTER DISTANCE** screen displays the current value in the current units of measurement (centimeters or inches); the **FILTER TIMEOUT** screen displays the current number of range readings selected for the filter distance. When you press **A** in either screen, the following prompt appears:

INPUT A NUMBER FOR THE SETTING

Enter the new value, which will be shown at bottom left of the display. Press ENTER to save it, and then **E** to return to the screen. Check that the correct value is now displayed.

Examples

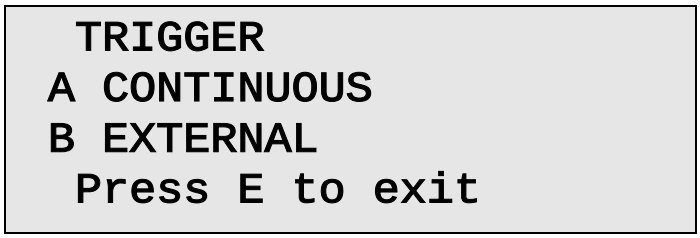
First range reading	3,500 cm
Filter distance	200 cm
Filter timeout	5 range readings
Valid reading must be	3,300 or greater

If there are no valid measurements, the signal remains at 3,500 cm. After five readings, the next range reading is valid whatever it is.

The Sentinel 3100 provides a sliding filter: that is, a valid reading resets the filter for the following readings:

First range reading	3,500 cm
Filter distance	200 cm
Filter time out	5 range readings
Valid reading must be	3,300 or greater
Second range reading	3,400 cm
Valid reading must be	3,200 or greater.

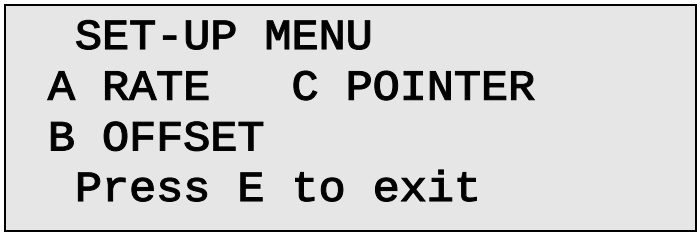
10.6.4 Trigger



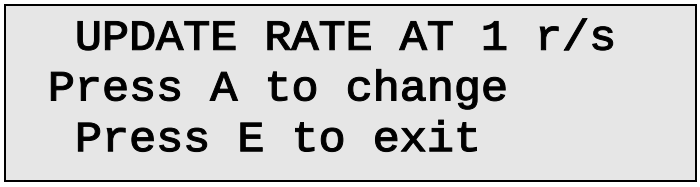
A CONTINUOUS
Updates automatically at set rate.

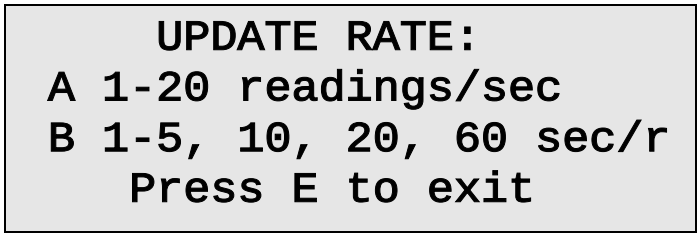
B EXTERNAL
Updates when TTL pulse received or **S** pushed on keypad.

10.7 Set-Up Screens



10.7.1 Rate





The measurement update rate is a function of the number of shots that are averaged, and is therefore related to the unit's accuracy and repeatability:

Fastest, least accurate, rate	20 readings/second
Slowest, most accurate, rate	5 seconds per reading.

When you press A, the following prompt appears:

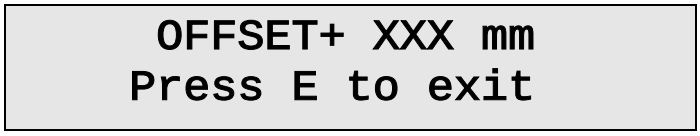
INPUT A NUMBER FOR THE SETTING

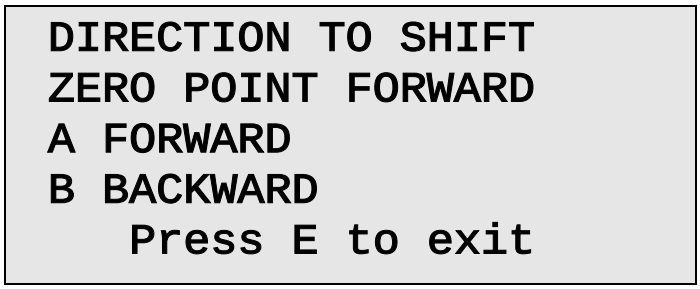
Enter the new value, which will be shown at bottom left of the display. Press ENTER to save it, and then E to return to the screen. Check that the correct value is now displayed.

Note that when the update rate is 19 readings per second, the actual rate will be 1 shot per reading. This feature is implemented for diagnostic purposes when single shots per reading need to be observed. Accuracy will be lower than for 20 readings per second.

For more information, see "Accuracy and Repeatability", page 30.

10.7.2 Offset



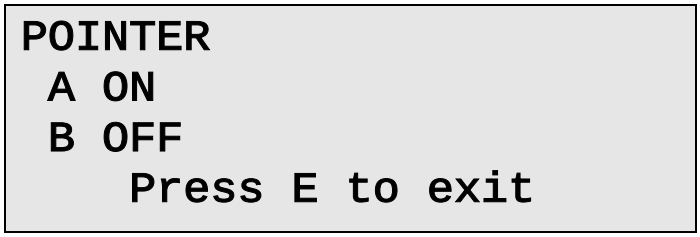


Allows the user to set the zero reference for the range readings:

A FORWARD
Set the zero reference point in front of the rangefinder.

B BACKWARD
Set the zero reference point behind the rangefinder.

10.7.3 Pointer



Turn the visible laser pointer on or off.

11 MAINTENANCE

11.1 Enclosure Window Cleaning and Maintenance

NOTICE

Window coating is delicate.

Do not use abrasive cleaners, squeegees or other cleaning implements that may mar or gouge the window coating.

1. Wash the window with a mild solution of soap and lukewarm water.
2. Using a soft cloth or sponge, gently wash the glass to loosen dirt and grime.
3. Rinse well with clean water.
4. To prevent spotting, thoroughly dry with a chamois or cellulose sponge.

11.1.1 Compatible Cleaning Agents

Aqueous Solutions of Soaps or Detergents

- Windex
- Joy
- Fantastik
- Top Job
- Mr. Clean
- Formula 409

Organic Solvents

- Butyl Cellosolve
- Kerosene
- Naphtha (VM&P) grade
- Hexcel, F.O. 554
- Neleco-Placer
- Turco 5042

Alcohols

- Methanol
- Isopropyl alcohol

Note: Remove all residual organic solvents with a secondary rinse.

11.1.2 Graffiti Removal

- Butyl Cellosolve for removal of paints, marking pen, lipstick, etc. Masking tape, adhesive tape and lint removal tools work well for lifting off old weathered paints.
- Kerosene or VM&P Naphtha for removal of labels, stickers, etc. If these solvents will not penetrate sticker material, apply heat (hair dryer) to soften the adhesive.

11.2 Enclosure O-Rings and Seals

The interface module is water-proof and dust-proof as long as all seals are installed and in good condition. When servicing the unit, check the module O-rings listed below:

Module	1	Lid/module seal
	2	Each cable conduit
Enclosure	1	Lid/enclosure seal
	1	Around D37 connector on enclosure lid
	2	Rangefinder transmit and receive windows
	1	Laser pointer window
	4	Mounting screws attaching module to enclosure
	6	Two mounting holes on each mounting boss.

For O-ring kits, contact Optech.

11.3 Fuses

There are three replaceable glass fuses (**F1**, **F2**, **F3**) on the interface board, as listed in the table below. Fuses are installed at the factory for the options ordered. Fuses are protected by reusable fuse covers.

The fuses **F2** and **F3** are laid out so that they cannot be installed together.

For		Install	
	10.5-30 VDC operation (standard)		**F1** and **F2**
	120 VAC operation (120 VAC option)		**F3**.

Table 5: Replaceable Fuses

Fuse	Rating	Function
F1	2 A	10.5-30 VDC power input (fast-blow) (24 VDC nominal)
F2	3 A	24 VDC rangefinder heater
F3	2 A	120 VAC line fuse
--	2 A	Internal rangefinder fuse (slow-blow)

The rangefinder is protected by a fourth fuse, located on the back of the rangefinder connector panel. Since **F1** is a fast-blow fuse, it will blow first. The rangefinder fuse can be replaced if necessary by opening the enclosure and the rangefinder (see "Servicing the Enclosure", page 57).

11.4 Storage

Store the Sentinel 3100 in a clean, dry environment at temperatures between -20° C and +70° C.

11.5 Returning the Sentinel 3100 to the Factory

Before returning the unit, note the serial number on the label and contact Optech or your Optech representative. If the problem cannot be resolved by telephone, fax or e-mail, Optech will issue a Return Authorization Number.

Do not ship a unit to Optech without a Return Authorization Number.

If the repair is covered by warranty, Optech will notify you and repair the unit promptly. If the repair is deemed chargeable, Optech will quote the estimated repair costs and proceed promptly upon your approval.

12 TROUBLESHOOTING

The following table outlines the troubleshooting information in this chapter.

Table 6: Troubleshooting Summary

Problem	Action
No operation (Section 12.3)	1. Check diagnostic LEDs. 2. Check unit temperature/Wait for unit to warm up or cool down.
Intermittent operation (Section 12.4)	1. Check error codes. 2. Check unit temperature. 3. Check operating environment. 4. Check programming values.
Erratic/fluctuating/short readings (Section 12.5)	1. Try filtered last-pulse mode. 2. Wait for unit to warm up. 3. Check rangefinder lens for dust.

Before contacting Optech, follow the troubleshooting procedures in the table above and then conduct a local test (Section 12.6).

12.1 Error Codes

Table 7 below lists the error codes that can be output.

Table 7: Error Codes

Code	Description	Serial Output	Analog Output
SATURATION	Return signal too strong (target/material highly reflective). Measurement may not meet typical accuracy specifications resulting in readings longer (DV model) or shorter (CP model) than actual distance.	^	N/A
PARTIAL DROPOUT	Fewer than 50% of laser shots returned to unit. Measurement valid but may not meet typical accuracy specifications.	<	N/A
SAT/DROPOUT	Both saturation and partial dropout. Measurement may not meet typical accuracy specifications resulting in readings longer (DV model) or shorter (CP model) than actual distance.	*	N/A
OUT OF RANGE	No laser shots returned to unit. No range provided.	NO RANGE	User selected

12.2 Diagnostic LEDs

The interface board and the rangefinder panel hold the three LEDs described in Table 8 below.

Table 8: Diagnostic LEDs

Colour	Normal Operation	Label	Function	Description
Yellow	Flashing	**LED 1**	**DATA OUT**	Data is being transmitted. Since data is sent after each laser burst, this also indicates the laser firing rate.
Red	Off	**LED 2**	**POINTER ON**	The laser pointer is programmed ON (default is OFF). Observe all safety precautions.
Green	On	**LED 3**	**POWER ON**	Power is being supplied to the rangefinder.

12.3 No Operation

IMPORTANT

For terminal block cabling, refer to wiring guide inside lid.

1. Check all external cabling, connections and associated equipment.

2. If the POWER ON LED is off, check that:
   - All heating and cooling equipment is functioning. The unit's thermal cutoff switches are self-resetting, and the unit is disabled and re-enabled without warning ("Thermal Protection", page 31).
   - Correct voltage is present at the correct terminals.
   - Fuses on the interface board are installed and functional (Table 5, page 49). The fuses are protected by reusable fuse covers.

3. If the unit is not communicating, check the DATA OUT LED:

   Not flashing:
   - Program the unit for continuous mode ("Range Resolution", page 38), or send an ASCII C.
   - Check that the D9 connector is securely attached.

   Flashing:
   - Check that the polarity of the field wiring is correct.

4. For 4-20 mA analog data, check that the analog current at the terminal block is correct.

12.4 Intermittent Operation

In Optech's experience, intermittent problems are usually related to the environment in which the unit operates. For this reason the Sentinel 3100 has been designed so that environmental problems can be distinguished from instrument problems with ease. The unit can also be tested locally, to eliminate any possible interference from the line or other equipment ("Local Test", page 56).

1. Check all external cabling, connections and associated equipment.

2. Check the serial output for error codes (Table 7, page 52).

3. Check that all heating and cooling equipment is functioning. The unit's thermal cutoff switches are self-resetting, and the unit is disabled and re-enabled without warning ("Thermal Protection", page 31).

4. If the unit is sending invalid output (PARTIAL DROPOUT, SAT/DROPOUT), check that:
   - No dust, smoke, steam, rain or other environmental condition is interfering with a clear line of sight between the unit and the target/material.
   - All windows and the sightglass (if provided) are clean.
   - The air curtain or spray ring is functioning properly (if provided).
   - The unit is programmed appropriately for its operating environment: window distance, window time out, analog limits, first/last-pulse mode.

5. If the analog output remains the same even when the range changes, check that the analog zero and maximum settings correspond to valid range readings (default 0-30 m). If the range differential is small when compared to the analog span, readings may appear not to change. For example, if ranges vary from 40-50 m and analog settings are for 0-200 m, the analog output may appear fixed.

12.5 Erratic/Fluctuating/Short Readings

Erratic or drifting range readings may be caused by interference between the rangefinder and the target/material, either from dust inside the rangefinder or from atmospheric interference such as dust or rain. Such readings may also be the temporary result of a cold unit that is warm enough to fire, but is still warming up internally.

If your unit is producing erratic readings or ranges that are much shorter than expected, there may be a build-up of dust on the transmitter lens inside the rangefinder. Especially in first-pulse mode, this may cause the unit to report a very short range reading (e.g., 0.05 m) to the enclosure window rather than to the target/material being measured.

Dust on the inside of the rangefinder lens is clearly visible in good light.

1. If the unit is in last-pulse mode: reprogram the unit to **filtered** last-pulse mode ("First/Last-Pulse", page 41). This may eliminate interference from dust, rain or similar particles.

2. After a low-temperature start: wait for about 15 minutes for the unit's internal temperature to stabilize. Range accuracy will gradually improve over this period.

3. Power the unit OFF.

4. Open the enclosure and remove the rangefinder ("Servicing the Enclosure", page 57).

5. Look into the transmitter lens (the right-hand lens) to check for dust.

6. If dust is visible, contact Optech for cleaning instructions. Do not open the rangefinder without direct authorization from Optech.

12.6 Local Test

If you have followed the steps in the previous section and the problem persists, test the unit to a known, portable target such as a cardboard sign. Use a digital multimeter and Optech's keypad (if provided) to test the analog and RS-232C serial output.

1. Reposition the Sentinel 3100 and range it to the portable target.

2. Note the programmed analog limits, and then reprogram them temporarily to conform to the target range (page 39).

3. If desired, use the laser pointer to confirm that the laser beam is hitting the target. For laser pointer safety precautions, see "Visible and Infrared Laser", page 7.

> **CAUTION**
>
> **Visible Laser Light - Do Not Stare Into Beam**
>
> Do not point or install the unit at eye level where people may be working.

4. Check the range output locally on the analog and serial lines:

RS-232C serial	Use Optech keypad or similar device.
Analog	Use digital multimeter.

5. Move the target while monitoring the unit's output.

6. Check that the serial and analog outputs ramp up smoothly.

7. If the range readings under test are:

Consistent	The problem may be related to the operating environment. Go to Step 8.
Inconsistent	Consult Optech.

8. Check all electrical interconnections and related equipment, and verify that there are no environmental obstacles such as dense dust and dirty windows.

9. Reprogram the unit with its original analog limits.

12.7 Servicing the Enclosure

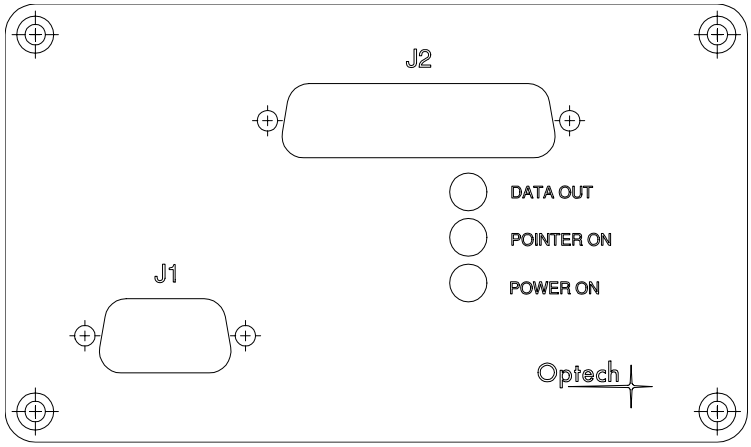


Figure 12: Rangefinder Connector Panel (Inside Enclosure)

NOTICE

Dust inside the rangefinder may cause incorrect readings. When the rangefinder is outside its enclosure, always keep the rangefinder in a clean and dust-free environment.

12.7.1 Removing the Rangefinder from the Enclosure

1. Power the unit OFF, and disconnect all external cabling.

2. Move the Sentinel 3100 to a clean environment such as a laboratory or office. Protect the inside of the unit from dust and dirt during this step.

3. Remove the top two hex head screws from the front window assembly. Do not remove the assembly itself, which is still attached by the bottom two screws.

4. Loosen the four captive screws on the enclosure lid. To avoid stripping the screws, do not loosen them any more than necessary.

5. Carefully lift the lid, with interface module, off the enclosure.

6. Place the lid upside down above the enclosure, so that the internal ribbon cable is exposed.

7. On the rangefinder base plate inside the enclosure, remove the four screws, one in each corner, that attach the base plate to the enclosure.

One screw secures the transmitter baffle, a curved, black-anodized aluminum component between the rangefinder lenses and the enclosure window, to the base plate. Remove this baffle carefully, and note its mounting orientation.

If your unit has a heater, ensure that the heater thermostat in one corner of the plate is not damaged while removing the screws.

8. If your unit has an AC power supply, two of the base plate screws attach the power supply to the enclosure. Carefully remove the power supply from the enclosure.

9. Carefully lift the base plate out of the enclosure, and turn it over.

10. Remove the four 4-40 x 3/8" screws that attach the rangefinder to the base plate.

11. If necessary, disconnect the ribbon cable from the rangefinder panel.

12. If you are not going to replace the rangefinder in the enclosure immediately:
    a) Check that there is no dirt or dust on the lid and O-rings.
    b) Re-install the base plate, enclosure lid and all O-rings.
    c) Check that all cables are inside the enclosure.
    d) Re-install the two top screws on the window assembly.
    e) Put the enclosure in storage.

12.7.2 Installing the Rangefinder in the Enclosure

1. In a strong light, check for dust on the inside of the rangefinder transmitter lens (the right-hand lens). If dust is visible the rangefinder may produce incorrect readings. In this case, contact Optech for cleaning instructions.

2. Turn the rangefinder base plate over.

3. Attach the rangefinder to the base plate by installing the four 4-40 x 3/8" mounting screws. Do not touch the rangefinder lenses.

4. Attach the transmitter baffle to the mounting screw by the rangefinder lenses. Ensure that the baffle curves around the right-hand lens (when looking into the lenses), separating it from the other lens.

5. Carefully lower the base plate into the enclosure.

6. Connect the ribbon cable securely from the enclosure lid to **J2** and **J1** on the rangefinder panel.

7. If your unit has an AC power supply:

   a) Carefully lower it into position on the base plate.

   b) Connect the ribbon cable to **J2** on the power supply.

8. Attach the base plate and power supply (if provided) to the enclosure by installing the four mounting screws, one in each corner.

9. Replace the enclosure lid and tighten the four captive screws.

10. Install the top two screws on the window assembly.

11. Cable, install, align and program the unit for operation.

13 APPENDIX: PRODUCT INFORMATION

This appendix contains information on product options available from Optech.

13.1 Hand-Held Programmer Communications Configuration

For use with the Sentinel 3100, Optech's handheld programmer can be configured with a baud rate of 9600 kbps.

To configure the handheld programmer:

1. Confirm that the keypad is powered by checking that the backlight is on or that data is displayed.
2. Simultaneously press the **F1**, **SHIFT**, and **CTRL** keys. Hold them down until the menu appears on the display.
3. Release the keys.
4. Follow the instructions on the display:
   a) To change the baud rate, press **F1** until the desired rate is displayed.
   b) To quit the menu without saving changes, press **F4**. The keypad settings will default to the original value when powered off and back on again.
   c) To save changes permanently, press **F5**.

13.2 Options

ITEM	SENTINEL					WATCHMAN				DEMO
	3100	3200	3310	3315	3400	3100	3200	3310	3315	3100
Keypad	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
120 VAC Power Supply	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
120 VAC Heater	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PG 13.5 Conduit	✓		✓	✓	✓	✓		✓	✓	✓
Air Curtain	✓		✓	✓	✓	✓		✓	✓	✓
Spray Ring	✓		✓	✓						✓
Sightglass – Pressurized	✓		✓	✓						✓
Sightglass – Unpressurized	✓		✓	✓						✓
Flange Gasket	✓		✓	✓						✓
Sealing Gaskets	✓		✓	✓						✓
Bezel Gasket	✓		✓	✓						✓
Universal Bracket	✓		✓	✓		✓		✓	✓	✓
Articulating Bracket	✓		✓	✓		✓		✓	✓	✓
Reflector Cluster	✓		✓	✓		✓	✓	✓	✓	✓
LEXAN Window	✓		✓		✓	✓		✓		✓

Figure 13: Options for Optech Level Monitors and Object Positioners

13.2.1 Hand-Held Programmer

See manufacturer's documentation for more information.

13.2.2 120 VAC Power Supply

See manufacturer's documentation for more information.

13.2.3 120 VAC Heater

See manufacturer's documentation for more information.

13.2.4 PG 13.5 Conduit Entry Set

- Replaces NPT conduit entries on field interface module
- Designed for non-armored control cables

13.2.5 Air Curtain

Use dry, oil-free, instrument air or nitrogen.

13.2.6 Spray Ring

For flange-mount applications only. See Figure 13-2.

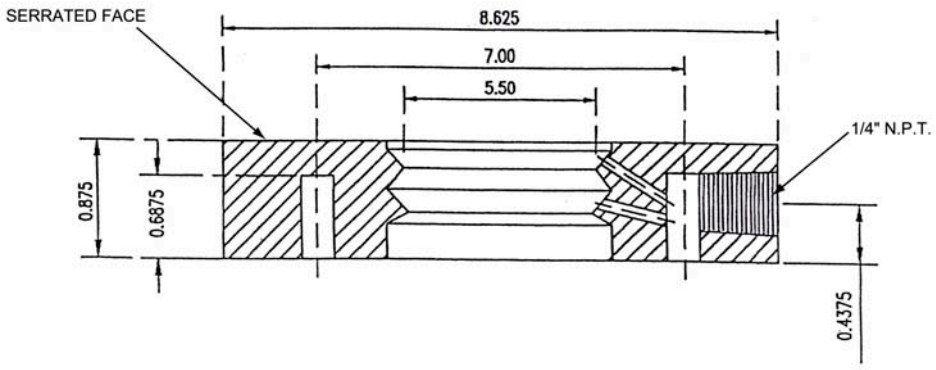


Figure 14: Spray Ring Flange Accessory

13.2.7 Sightglass and Gaskets

For flange-mount applications only, must be ordered together. Available in 150, 300 and 600 class, and in 4″ and 6″ sizes.

Flange gasket	Seals your flange to Optech sightglass.
Bezel gasket	Seals Optech unit to Optech sightglass.

13.2.8 Sightglasses

- Metaglass sightglass for pressure applications
- LEXAN sightglass with 150 class for unpressurized applications

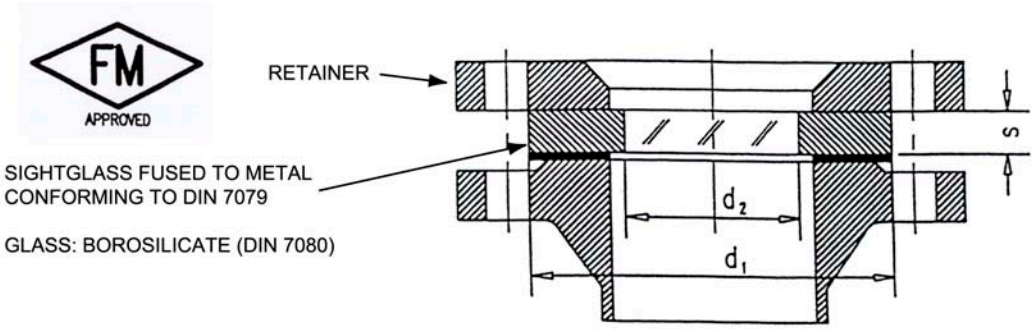


Figure 15: Sightglass and Retainer Flange Accessory

13.2.8.1 Sightglass Installation

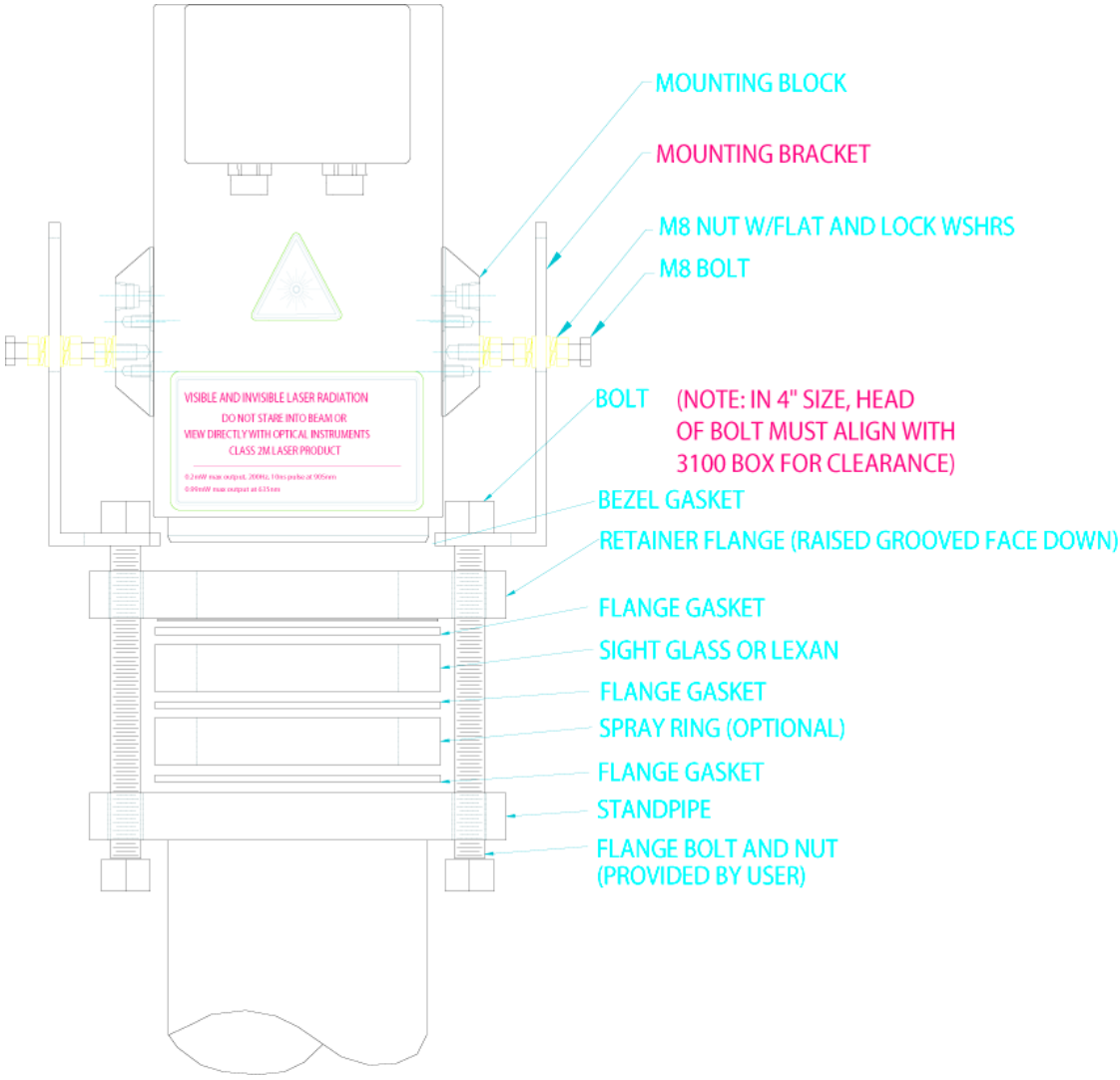


Figure 16: Sightglass and Gasket Installation (Front View)

1. Ensure the sightglass and bezel glass are clean and free from dirt or oil. If they are dirty, clean them with a commercial glass cleaner.
2. Remove the white backing from the foam bezel gasket, and attach the gasket over the unit window frame, with the thick part over each other so that the screws are visible.
3. Place components on the standpipe as shown in the above illustration, with the raised grooved face down towards the tank, and the spray holes (if spray ring supplied) facing up toward the sightglass.
4. Bolt the retainer flange to the standpipe using only 6 bolts. Then insert the mounting brackets opposite each other, and hand-tighten them with the two remaining bolts.

5. Place the unit in the center of the brackets. Then insert the M8 bolts, nuts and flat/lock washers as shown in the above illustration. Insert the M8 bolts all the way into the block, leaving the nuts loose.
6. Center the unit and slide the two brackets until both rest on the retainer flange. Then tighten the brackets.
7. Push down the centered unit on the top, and then tighten the rest of the M8 nuts.

Notes:

- Figure 16 above covers 4" and 6" non-pressurized, class 150#, 300# and 600# flanges.
- In the 6", 300# and 600# application, rotate the brackets 180° around the flange bolt and bolt them directly to the mounting block. Nuts are not necessary.

13.2.9 Articulating Bracket

For 3100/3310/3315 enclosures when they are not flange-mounted.

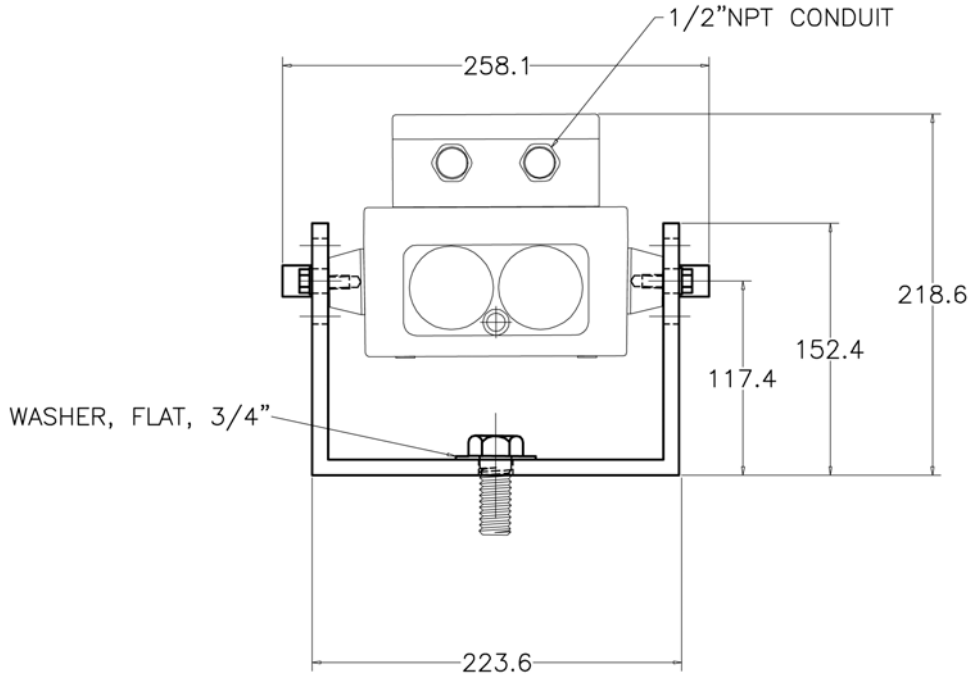


Figure 17: Articulating Bracket, Front View

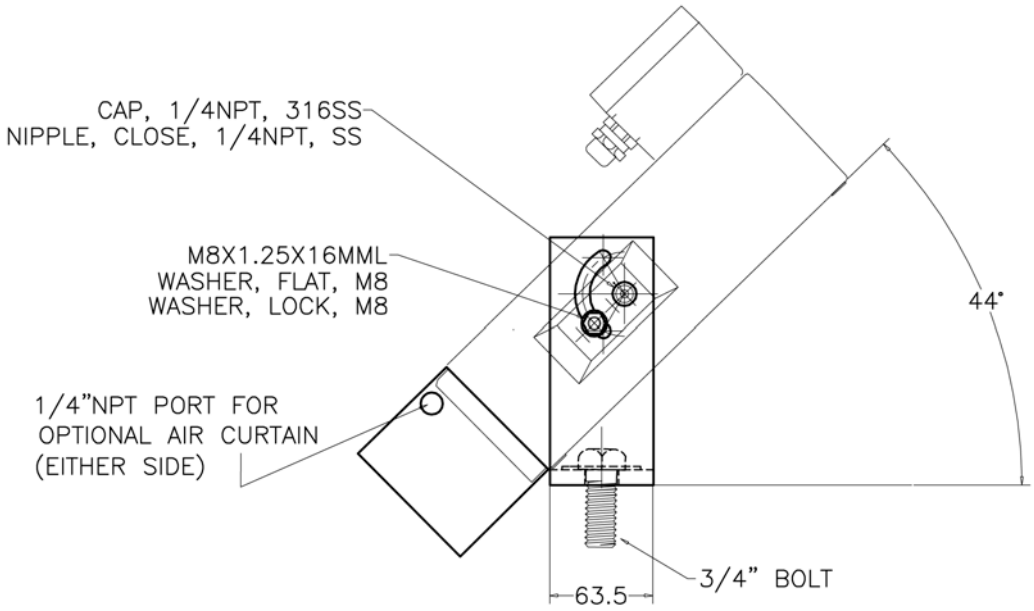


Figure 18: Articulating Bracket, Side View

13.2.9.1 Articulating Bracket Installation

Required Components

1 Articulating bracket
1 3/4-10 x 1 1/2″ hex bolt
1 3/4-10 nut
2 3 1/4″ flat washer
2 M8 x 18 mm hex bolts
2 M8 flat washers
2 1/4″ NPT SS close nipples
2 1/4″ NPT SS caps

Note: Caps and nipples usually shipped as one assembly, with nipples screwed on to caps.

Procedure

1. Mount the articulating bracket to a stable surface, using the 3/4-10 bolt, washers and nut.
2. Mount the unit to the artculating bracket, using the two 1/4″ NPT close caps/nipples and the two M8 bolts and washers. Tighten the caps/nipples, but leave the M8 bolts loose.

3. Using the caps/nipples as a pivot point, adjust the vertical position of the unit with a large screwdriver.
4. Adjust the horizontal position of the unit using the 3/4-10 bolt.
5. When the unit is correctly mounted, tighten all bolts.

13.2.10 LEXAN Window

- Standard on all enclosures except the 3200 and 3315
- Not intended for explosion-proof environments or high-temperature applications

13.2.11 Reflector Clusters

- For Watchman object positioner applications
- Minimum quantity of 3

13.3 Electrical Interface Detail

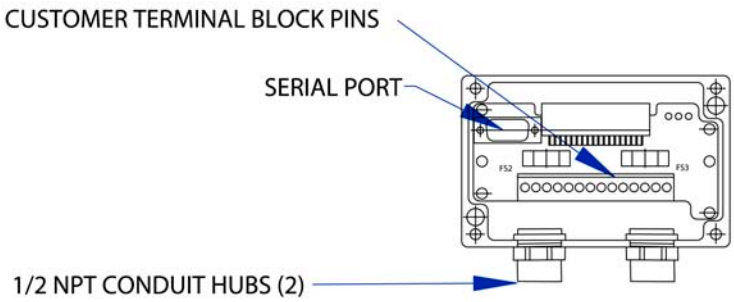


Figure 19: Electrical Interface Detail

Table 9: Terminal Block Pin Descriptions

Terminal	Connection
1	+24 VDC
2	-24 VDC
3	Spare
4	Analog Current Loop 4-20 mA -
5	Analog Current Loop 4-20 mA +
6	RS-422 Transmit +
7	RS-422 Transmit -
8	Data Common
9	LASER ENABLE
10	EXTERNAL TRIGGER
11	Spare
12	120 VAC Line (Option)
13	120 VAC Neutral (Option)
14	AC Ground (Chassis Ground)